

INFORMATION REPORT INFORMATION REPORT

CENTRAL INTELLIGENCE AGENCY

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COUNTRY USSR

REPORT

SUBJECT Soviet Production of Diesel Engines
and Tractors

DATE DISTR. 26 April 1961

NO. PAGES 1

REFERENCES RD

DATE OF
INFO.

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SOURCE EVALUATIONS ARE DEFINITIVE. APPRAISAL OF CONTENT IS TENTATIVE.

Attachment 1: Details on production, labor, and working hours at the Ordzhonikidze Tractor and Diesel Plant, the Dynamo Works, and the "Sickle and Hammer" Diesel Plant, in Kharkov.

Attachment 2: Detailed report on production of diesel engines in the USSR including detailed charts on technical characteristics of some Soviet diesel engines.

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INFORMATION REPORT INFORMATION REPORT

TECHNICAL CHARACTERISTICS OF SOME RUSSIAN DIESEL ENGINES

(b) FOUR-STROKE ENGINES

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	D50	D6A 48	K 157	D6 75-2	D70	D 6 M (Various models)	D 12A (Various models)	M 50
<u>CYLINDERS</u>								
Bore & Stroke, mm.	115 x 120		120 x 140		130 x 140	150 x 180		180 x 200
Capacity								
Number	4	6	6	6	---	6	12	12
Form	---	---	In line	---	---	In line	V	V
Total capacity	---	---	---	---	---	---	---	---
<u>BLOWER</u>								
Type	---	---	Supercharged by turbo-blower	---	---	---	---	Supercharged; 1.5 to 1.6 kg/cm ²
Delivery Pressure -	---	---	---	---	---	---	---	---
<u>PERFORMANCE</u>								
Continuous { Power (HP) at Speed (R.P.M.)	55 at 1500	80 at 1500	115 at 1500	115 at 1500	---	150 at 1500	300 at 1500	500 at 1200 1000 at 1700
HP/CYL.	13 3/4	13 1/2	19	19	---	25	25	42
Maximum rating (H.P.)	---	---	120 (30 mins)	---	---	---	---	---
Minimum idling speed, r.p.m.	600	---	700	---	---	---	---	---
<u>CONSUMPTION</u> (Continuous rating)								
Fuel Gm/HP/HR Lb/HP/HR	---	200 0.44 x 55	195 0.43	195 x 55 0.43	---	185 0.407	180 0.396	190 0.419
Oil Gm/HP/HR Lb/HP/HR	---	650 1.4	600 1.32	700 1.54	---	10 0.022	10 0.022	6 0.0132
<u>SERVICE LIFE</u> (Hours)	---	---	5000	---	---	3000	1500	---
<u>DIMENSIONS</u>								
Length, mm/in	---	3760/150	1788/71	3435/137	---	---	1420/57	2600/104
Width, mm/in	---	1470/59	867/35	803/32	---	---	1065/43	1220/49
Height, mm/in	---	820/33	1104/44	1295/52	---	---	1035/41	1220/49
Weight, Kg Lb.	---	2205 4850 lb.	1090 2400	2100 4620	---	---	---	1700 3740
<u>MADE AT</u>								
<u>APPLICATIONS</u>	---	Diesel-Generator Volts 400 Freq. 250	---	Diesel-Generator	---	---	---	*Rocket* & *Helicopter* Hydrofoil *Craft*
<u>OTHER INFORMATION</u> <u>AND COMMENTS</u>	---	---	Not reversible	Generator = 75 HP Alternating 3-phase Freq. 50 Voltage 400 or 250	---	---	---	Fitted with Reversing Gearbox

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TECHNICAL CHARACTERISTICS OF SOME RUSSIAN DIESEL ENGINES

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(A) TWO-STROKE ENGINES

	OPPOSED PISTON TYPES			SINGLE PISTON TYPES					
	2D, 1100	2D, 1200	2D, 1300	510A	1200	1300	1400	1600	510B
<u>CYLINDERS</u>									
Bore & Stroke, cm.	206.4 x (254 x 2)			250 x 500	300 x 450	NO INFORMATION AVAILABLE			
Capacity	---	---	---	---	---	---	---	---	---
Number	10	10	12	12	8	---	---	---	---
Form	In line			V	In line	---	---	---	---
Total capacity	---	---	---	---	---	---	---	---	---
<u>ROVER</u>									
Type	Originally fitted with Roots Blower		2 turbochargers followed by mechanically driven centrifugal compressor, then cooled.	2 turbochargers with inter-cooling, followed by mechanically driven blower.					
<u>PERFORMANCE</u>									
Continuous Power (HP) at Speed (R.P.M.)	2000 at 850	---	3000	2000 at 750	2000 at 500	---	---	---	---
HP/CYL.	200	200	250	185	250	---	---	---	---
Maximum rating (H.P. at r.p.m.)	---	---	---	2500 at 780	---	---	---	---	---
Minimum idling speed	---	---	---	500 rev/min.	---	---	---	---	---
<u>CONSUMPTION</u> (at maximum rating)									
Fuel GM/HP/HR LB/HP/HR	---	---	---	---	---	---	---	---	---
Oil GM/HP/HR LB/HP/HR	---	---	---	---	---	---	---	---	---
<u>SERVICE LIFE</u> (hours)									
<u>DIMENSIONS</u>									
Length, m/in	---	---	---	3735/149	---	---	---	---	---
Width, m/in	---	---	---	1750/69	---	---	---	---	---
Height, m/in	---	---	---	2190/88	---	---	---	---	---
Weight, Kg	---	---	---	9500	---	---	---	---	---
	---	---	---	20950	---	---	---	---	---
<u>MADE AT</u>	LUGANSK or KARLYSHEV	---	---	KOLCHINA (Moscow district)	---	---	---	---	---
<u>APPLICATIONS</u>	Used primarily for diesel-electric RI and possibly high speed marine			Marine	---	---	---	---	---
<u>OTHER INFORMATION AND COMMENTS</u>	Now developed up to 3000 bhp fitted with two assisted turbochargers.			Marine engine reversing, if to be developed as it will give at least 3000 bhp (and possibly with 16 cylinders) with 16 cylinders, efficient scavenging, fitted with air start	---	---	---	---	---

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TECHNICAL CHARACTERISTICS OF SOME RUSSIAN DIESEL ENGINES

(3) FOUR-STAGE ENGINES (Continued from Sheet 2)

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	10 6H	20 6H	30 6H	H. 75	10 12 H Also 10 12 50	40 19/30 - 1	?	2. 50
CYLINDERS:								
Bore & Stroke, mm.		150 x 180		180 x 200	150 x 180	190 x 300	260 x 270	318 x 330
Capacity	---	---	---	---	---	---	---	---
Number	6	6	6	12	12	4		6
Form		In line		V	V	In line		
Total capacity	---	---	---	---	---	---	---	---
PLEYER:								
Type	---	---	Turbo-charged (Turbo-inject temp. 550° C)	Turbo-charged	turbo-charged	---	---	turbo-charged
Delivery Pressure								
PERFORMANCE:								
Continuous Power (HP) at Speed (R.P.M.)		250 at 1500		1000 at 1500	500 at 1500	300 at 600	---	1000 - 1500 at 750
HP/CYL								
Maximum rating								
Minimum idling speed, r.p.m.								
CONSUMPTION (first class rating)								
Fuel								
GM/HP/HR	175	180	175	170	---	180	---	---
LB/HP/HR	0.386	0.396	0.386	0.374	---	0.396	---	---
OIL								
GM/HP/HR	8	8	8	5	---	6	---	---
LB/HP/HR	0.0176	0.0176	0.0176	0.011	---	0.0132	---	---
SERVICE LIFE: (HOURS)	3000	3000	---	6000	2000	---	---	---
DIMENSIONS								
Length, in/in	1778/71	2070/83	2462/98	2395/96	1777/71			
Width, in/in	887/36	887/36	882/35	1115/45	1052/42			
Height, in/in	1115/45	1115/45	1163/47	1350/54	1090/44			
Weight, Kg	1335	1635	1815	1800	1850			
LB	2940	3600	4000	4000	4080			
MADE AT:		ALTAY (Siberia)		LENINGRAD	ALTAY	---	---	BRIANSK or PENZA
APPLICATIONS:	---	---	---	---	---	---	---	Used mainly for locos heavy shunting.
OTHER INFORMATION								
NOTES:	---	---	---	Turbo-charger with: tela compressor outlet vaneless diffuser, water cooled, & entry turbine-radial fully tailored nozzle plug- pulse charging Engine oil lub. to overhung plain bearings.	Turbo-charger with: 2 entry exhaust turbine inlets, centrifugal turbine on constant pressure. Overhung plain bearings air/oil cooled turbo-blower.	---	Prof. Glogotiev's compound engine.	

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*10 12 50
Dual Fuel
300 h.p. at 1500 r.p.m.

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U.S.S.R.ECONOMICKHARKOV Tractor and Diesel Engine Plants1. ORJONIKIDZE Tractor and Diesel Plant

- a) Tractor production commenced in about 1931 with a wheeled tractor of International Harvester origin. By 1936 the plant was producing its own designs of tracked vehicles.
- b) At the present time, the factory produces a variety of sizes and types of tractor ranging from light, single cylinder engine, wheel tractors, medium sized enclosed cab crawler to large multi-wheeled haulage vehicles and special purpose tractors. Originally all engines were for petrol but now only diesel engines are produced.
- c) The factory is mainly self-supporting and only the minimum of finished parts and assemblies are procured from outside.
- d) The plant has its own foundry which includes facilities for precision casting; it also has its own forge shop.
- e) The plant employs approximately 30,000 people with a high proportion of women operators, particularly in machine shops. Operators in engine and tractor assembly lines on the other hand are almost entirely male.
- f) Output of tractors is approximately 170 per day, 100 of which are of the tractor type and 70 of the wheeled. They are anxious to increase output under the current Seven-Year Plan. In order to achieve this object it is not intended to extend the works but to get the result by increasing mechanisation and automation.
- g) Basic design and research work is not done at the plant but at centralised engineering institutes; these institutes hold meetings for collaboration with the plant at intervals of three months. Any new product is first to be approved by these institutes in the complete prototype form and with field trials.

/h) The factory works

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- h) The factory works a 41-hour week of six days, seven hours per day being worked from Monday to Friday and six hours on Saturday. Normal working is two shifts per day.
- i) There is no evidence of any components suitable for tanks being manufactured and there is an absence of special security regulations.

2. KHARKOV Dynamo Works

This plant produces heavy diesel engines up to those of 2,000 h.p.

3. "SICKLE AND HAMMER" Diesel Plant

- a) This plant produces diesel engines chiefly for agricultural machinery such as grain and cotton harvesters. The engines are similar in design to those employed in tractors.
- b) The factory was founded in 1872 by a German and an Englishwoman. During its history the plant has produced all types of agricultural machinery and motor cycles. At the present time manufacture is concentrated on diesel engines in the 70 h.p. class.
- c) The plant employs something over 10,000 people, approximately 35% of which are female operators; 90% of the workers in the machine shops are women. Assembly lines, however, are almost entirely staffed by men.
- d) Present production is at the rate of 125 engines per day, largely in the 70 h.p. rating.
- e) Plans exist for increasing output which is to be achieved by the introduction of more mechanization and automation rather than by any extension of the plant. A target has been set for the daily production to rise to 700 by 1965 when the plant is scheduled to have about forty separate automatic production lines. It is anticipated that it will not be necessary to increase personnel by more than some 5 to 10%.
- f) Prices of engines will be reduced by 22% during 1961 and new production lines will be amortised over the following four years.
- g) Hours worked are similar to those in the ORJONIKIDZE plant.
- h) The plant is largely self-sufficient and equipment bought outside is kept to a minimum.
- i) The general design of engine is conventional.

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U.S.S.R.*Ad*ECONOMICDiesel Engines1. General

U.S.S.R.-produced diesel engines are for the most part of normal Western design or emanated from copies of Western engines. Russian engineers are now, however, branching out into more advanced lines of independent thought. The majority of engines are fairly ordinary although generally fitted with turbo charges.

2. Two new engines for locomotion

- a) The first engine is a compounded four stroke being developed at the Lenin Polytechnic Institute, KHARKOV. Particulars are attached at Appendix "A".
- b) The second is a two stage blown four stroke engine of a type now on exhibition in MOSCOW. This engine is of the twelve cylinder two stroke design in Vee form with free running turbo charges on each bank feeding a common mechanically driven second stage with after-cooling. The engine is continuously rated at 2,200 H.P. at 750 r.p.m. Plans are in hand for development of this engine up to a rating of 3,000 H.P. and possibly with sixteen cylinders. If this is successful the engine will be used for locomotion. Some particulars of the engine in its present twelve cylinder design and designated "40 D" will be found at Appendix "B".

3. Technical details of some Soviet diesel engines in production

- a) 50X1-HUM
- b) The following is a list of plants manufacturing diesel engines:

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KHARKOV
(Ukraine)

Transport Machinery Plant MALYSHEV producing locomotives and believed also diesel engines. These might be the D.100 series engines having opposed piston two strokes (similar to Fairbanks Morse) and also the two stage blown version 9 D.100 of 3,000 H.P. for the T.E.30 locomotive.

/LUGANSK

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LUGANSK (Ukraine)	This may be producing the same engine as MALYSHEV.
KOLOMNA (Moscow district)	40.D
BRIANSK	D.50 Burmeister and Wain engines made under licence
PENZA	Perhaps D.50
ALTAY (Siberia)	1D.12GD 1D.12N 3D.6N
LENINGRAD	Russian Diesel Works producing marine engines M.756
KIROV	TOKMAK Plant. K.157
CHELYABINSK	Type not known but 145 x 205 mm. bore and stroke, 4 cylinder, turbo-charged 135 H.P. at 1050 r.p.m.

4. Engines for possible strategic application

Two engines of present Russian manufacture, namely the M.50 and M.756, might be used as tank engines. They are 12 cylinder Vee engines. The detailed design is very good and is the result of considerable development, e.g. wet cylinder liners are double skinned with spiral flow directing splitters between the skins. The object of this is to reduce cavitation in the coolant. Similar engines are used to power the latest Russian hydrofoil "Rocket" and "Meteor" craft being built on the Volga at ^CKORNY.

5. Technical Points in Design

- a) All diesel engines used in tractors have aluminium/tin alloy steel backed bearings probably of the antimony low tin type. The exception is the crank shaft locating bearing which is of a thick copper lead type. Aluminium/tin bearings used in the STALINGRAD Works are produced from clad steel strip.
- b) Cadmium or tin coatings on the backs of shells are in common use.
- c) All engines have removable wet liners. Fuel injection equipment is of the conventional type, some plants manufacturing their own equipment as, for instance, the ORJONIKIDZE Tractor and Diesel Plant, KHARKOV.

/d) Crank shafts

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- a) Crank shafts for four cylinder engines are dynamically balanced to 5 gm/cm. while in the production line.
- e) Most of the machinery for connecting rods in diesel engines is broached, i.e. after slitting the big end eye and rough milling the cut faces the bores and side faces are broached.

6. Technical Institutes for diesel engine design

The BAUMANN Technical Institute in MOSCOW ranks as the most important [] in the U.S.S.R., followed by the LENIN Polytechnic Institute in KHARKOV. The buildings and laboratories of both these institutes are not up to date as compared with similar [] in the West.

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APPENDIX "A"

Effective horsepower of installation	3,000 b.h.p.
Power of the diesel engine	2,400 b.h.p.
Power of the gas turbine	1,100 b.h.p.
Surplus power of turbine (included in the above figures) transmitted to the crankshaft	600 b.h.p.
Diesel engine r.p.m.	1,000
Gas turbine r.p.m.	12,000
Compression ratio of engine	13.5 to 1
Bore	240 mm.
Stroke	270 mm.
Number of cylinders	16
Disposition of cylinders	45 deg. Vee
Mean piston speed	9 m. per sec.
Boost pressure	2.52 kg per sq. cm.
Gas pressure at turbine entry	3.8 kg per sq. cm.
Charge air temperature	350 deg. abs.
Gas temperature at turbine entry	600 deg.
Specific fuel consumption	175-150 gms. per b.h.p. - hr.
Specific weight of installation	50 kg. per b.h.p.
Design weight of installation	15 tons
Dimensions:-	
Length (including generator)	5.45 m.
Width	1.6 m.
Height	2.08 m.
Specific volume	1.82 litres per b.h.p.

The general standard of the above unit and of the installation and instrumentation are good and much as would be found in the West.

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